In Situ Instrumentation for Sub-Surface Planetary Geochemistry

J. Bodnarik^{1*}, L. Evans¹, S. Floyd¹, L. Lim¹, T. McClanahan¹, M. Namkung¹, A. Parsons¹, J. Schweitzer², R. Starr¹, J. Trombka¹

NASA GSFC, Code 691, Greenbelt, MD 20771, USA (*correspondence: julia.g.bodnarik@nasa.gov)
 University of Connecticut, Storrs, CT 06269, USA

Instrumentation Development

Novel instrumentation is under development at NASA's Goddard Space Flight Center, building upon earth-based techniques for hostile environments [1,2], to infer geochemical processes important to formation and evolution of solid bodies in our Solar System. A prototype instrument, the Pulsed Neutron Generator - Gamma Ray and Neutron Detectors (PNG-GRAND), has a 14 MeV pulsed neutron generator coupled with gamma ray and neutron detectors to measure quantitative elemental concentrations and bulk densities of a number of major, minor and trace elements at or below the surfaces with approximately a meter-sized spatial resolution down to depths of about 50 cm without the need to drill. PNG-GRAND's in situ meter-scale measurements and adaptability to a variety of extreme space environments will complement orbital kilometer-scale and in situ millimeterscale elemental and mineralogical measurements to provide a more complete picture of the geochemistry of planets, moons, asteroids and comets.

Preliminary Testing and Results

We are optimizing the PNG-GRAND instrument configuration and refining our analysis techniques through experimentation at our unique outdoor test facility. We will present results (Fig. 1) that demonstrate PNG-GRAND's capabilities for elemental composition measurements.

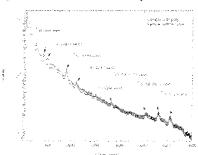


Figure 1.
Gamma ray
spectra obtained
with PNGGRAND on a
2x2x2 m granite
structure with
and without a
simulated water
layer.

[1] Grau et al. (1993) Nucl. Geophys. 7, 173-188. [2] Schweitzer (1993) Subsurface Measurements for Geochemical Analysis. In Remote Topics in Remote Sensing 4 (eds. Pieters and Englert). Cambridge Univ. Press, Cambridge. pp. 485-505.